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- (56)
- References Cited**

- U.S. PATENT DOCUMENTS
- | | | | |
|-----------|---|---------|----------|
| 5,473,176 | A | 12/1995 | Kakumoto |
| 5,637,898 | A | 6/1997 | Baliga |
- (Continued)

- FOREIGN PATENT DOCUMENTS

- | | | |
|----|-------------|--------|
| CN | 1 360735 A | 7/2002 |
| CN | 101238581 A | 8/2008 |
- (Continued)

- ## OTHER PUBLICATIONS

- JP2009-224365 machine translation.*
(Continued)

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- (57) **ABSTRACT**

- A silicon carbide substrate including a first layer having first conductivity type, a second layer having second conductivity type, and a third layer having the first conductivity type is formed. A trench provided with an inner surface having a side wall surface and a bottom surface is formed, the side wall surface extending through the third layer and the second layer and reaching the first layer, the bottom surface being formed of the first layer. A silicon film is formed to cover the bottom surface. A gate oxide film is formed on the inner surface by oxidation in the trench. The gate oxide film includes a first portion formed by oxidation of the silicon carbide substrate, and a second portion formed by oxidation of the silicon film on the bottom surface. Accordingly, a method for manufacturing a silicon carbide semiconductor device having a high breakdown voltage is provided.

- ### Related U.S. Application Data

- (63) Continuation of application No. 13/958,115, filed on Aug. 2, 2013, now Pat. No. 9,087,693.
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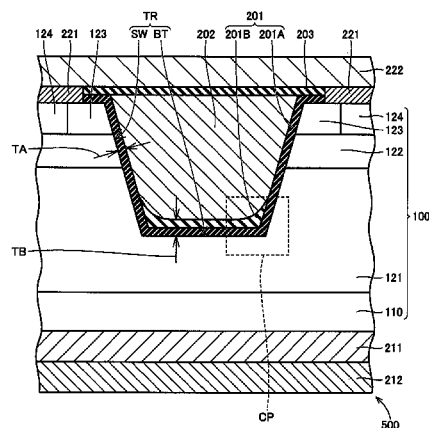
- (30) **Foreign Application Priority Data**

- Sep. 12, 2012 (JP) 2012-200178

- (51) **Int. Cl.**
H01L 29/66 (2006.01)
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- (52) **U.S. Cl.**
CPC ... **H01L 29/66666** (2013.01); **H01L 21/02529**
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- (58) **Field of Classification Search**
None
See application file for complete search history.



9 Claims, 13 Drawing Sheets